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LIQUID CRYSTAL DISPLAY, COLOR FILTER SUBSTRATE, AND ARRAY SUBSTRATE

[Abstract]

PROBLEM TO BE SOLVED: To provide a liquid crystal display which can attain improvement in a display quality level while forming a pillar-shaped spacer also at the outside of a display area of a substrate, and improve an alignment defect.

SOLUTION: This liquid crystal display device is provided with an array substrate having pixel electrodes and switching active elements which drive the pixel electrodes, a color filter substrate 1a having counter electrodes for the pixel electrodes, the pillar-shaped spacers 5 each of which is formed with the predetermined pattern shape, the predetermined height, and the predetermined density on the color filter substrate 1a, and alignment marks 16 used for

positioning which are formed on the outside 17a of display area on the color filter substrate 1a. The liquid crystal is enclosed in a space between the array substrate and the color filter substrate 1a, and the pillar-shaped spacers 5 are provided in the positions other than the alignment marks 16 parts and their vicinities on the color filter substrate 1a. Thereby, when the alignment marks 16 overlap with the pillar-shaped spacers 5, the problem that discrimination of the marks 16 from the spacers 5 becomes difficult cannot be brought about.

[Claims]

[Claim 1]

A liquid crystal display apparatus including alignment marks, which are formed in regions other than a display region on a pair of opposite substrates having intervening a liquid crystal layer therebetween and are used for positioning, and a pole-shaped spacer formed at one of the opposite substrates,

wherein the pole-shaped spacer is provided at the alignment mark portion and a location of the substrate other than the alignment mark portion.

[Claim 2]

A liquid crystal display apparatus including an array substrate having a pixel electrode and a switching active element that drives the pixel electrode, a color filter substrate having an opposite electrode of the pixel electrode, a pole-shaped spacer having a predetermined pattern shape, a predetermined height and a predetermined density and formed on the color filter substrate, and alignment marks, which are formed in regions other than a display region on the color filter substrate and are used for positioning, wherein liquid crystal is filled into a gap between the array substrate and the color filter substrate,

wherein the pole-shaped spacer is provided at the alignment mark portion on the color filter substrate and a location of the substrate other than the alignment mark portion.

[Claim 3]

A liquid crystal display apparatus including an array substrate having a pixel electrode and a switching active element that drives the pixel electrode, a color filter substrate having an opposite electrode of the pixel electrode, a pole-shaped spacer having a predetermined pattern shape, a predetermined height and

a predetermined density and formed on the color filter substrate, and alignment marks, which are formed in regions other than a display region on the color filter substrate and are used for positioning, wherein liquid crystal is filled into a gap between the array substrate and the color filter substrate,

wherein the pole-shaped spacer is provided at the alignment mark portion on the array substrate and a location of the substrate other than the array substrate portion.

[Claim 4]

A color filter substrate including an opposite electrode of a pixel electrode formed on an array substrate, wherein an alignment mark used for positioning is provided other than a display region, and a pole-shaped spacer having a predetermined pattern shape, a predetermined height and a predetermined density is provided at the alignment mark portion and at a location other than the alignment mark portion.

[Claim 5]

An array substrate having a pixel electrode and a switching active element that drives the pixel electrode, wherein an alignment mark used for positioning is provided other than a display region, and a pole-shaped spacer having a predetermined pattern shape, a predetermined height and a predetermined density is provided at the alignment mark portion and at a location other than the alignment mark portion.

[Title of the invention]

LIQUID CRYSTAL DISPLAY, COLOR FILTER SUBSTRATE, AND ARRAY SUBSTRATE

[Detailed Description of the Invention]

[0001]

[Field of the Invention]

The present invention has its object to improve a characteristic of a liquid crystal display apparatus, the display quality and the yield. The present invention relates to a liquid crystal display apparatus, a color filter substrate and an array substrate, wherein a pole-shaped spacer is formed on a surface of a substrate.

[0002]

[Description of the Prior Art]

A schematic cross-sectional view of a liquid crystal display apparatus (hereinafter, referred to as "liquid crystal panel") of a conventional thin film transistor (hereinafter, referred to as "TFT") is shown in FIG. 8. The TFT type liquid crystal panel 31e consists of an array substrate 11e and a color filter substrate 1e.

[0003]

A substrate 1e includes a glass substrate 2a, a light-shielding film 4 formed on the glass substrate 2a, a color filter having RGB coloring films 6R, 6G and 6B, and a transparent electrode 10.

[0004]

One of array substrate 11e includes a glass substrate 2b, active elements 3a and 3b, which are formed on the glass substrate 2b and include a signal line and a scan line, and a pixel electrode 8.

[0005]

Orientation films 9a and 9b are formed on a surface of the substrate 1e and a surface of the array substrate 11e, which are opposite to each other. Further, gaps formed between the substrates 1e and 11e with spherical shape spacers 15 therebetween are filled with liquid crystal 14. The periphery thereof is fixed by a sealant 13. In addition, a polarization plate can be attached on a panel surface depending upon the use of a liquid crystal panel 31e.

[0006]

The conventional TFT the liquid crystal panel 31e has the following subjects exist.

[0007]

Firstly, gap accuracy between the array substrate 11e and the color filter substrate 1e significantly decides the display quality. That is, where gap irregularities exist within the panel surface, a strain is generated within the plane. Thus, if the panel gap deviates from a design value, there is a problem in that a panel characteristic such as , contrast is degraded.

[0008]

Secondly, where black display is implemented by applying a voltage to a panel through the spherical shape spacer 15 existing between the light-shielding films 4 of a pixel, among the spherical shape spacer 15 existing between the array substrate 11and the color filter substrate 1e, light leakage is generated in the spherical shape spacer 15, and black display is degraded. That is, contrast with while display is degraded.

[0009]

Thirdly, if the above panel is to be formed, spacers are sprayed on the substrate by means of dry or wet mode in order to allow the spherical shape spacer 15 to exist on the substrate. When the spacers are sprayed, point defect portions are generated within the panel due to aggregation of the spacers or introduction of alien substance. That is, the point defect portions degrade the yield in the panel process.

[0010]

For the above reasons, recently, a method of previously forming a pole-shaped spacer on the substrate has been proposed instead of the spherical shape spacer using the conventional spray method.

[0011]

However, even if the pole-shaped spacer method is employed instead of the conventional spherical shape spacer spray method, the spacers have to exist in the entire glass substrate including regions other than the display region (a seal pattern, etc.) as well as the display region in the same manner as the conventional spherical shape spacer.

[0012]

That is, as shown in FIG. 9(b), if the pole-shaped spacers 5 exist only in the display region of the liquid crystal panel 31, portions other than the display region 17b are adhered by means of pressurization from the up and down directions of the substrates 1d and 11d in an adhesion process of the panel assembly process. Thus, a gap adjacent to the seal 12b of the display region 7b within the seal 13 becomes great, and the seal is hardened as it is. Accordingly, a display stain is generated adjacent the periphery of the panel in a panel completed product into which liquid crystal is injected.

[0013]

Therefore, as shown in FIG. 9(a), the pole-shaped spacer 5 exits even in a portion 17 outside the display region over the entire substrate 1c. Thus, even if pressure is applied from the top and bottom of the substrates 1c and 11c in the adhesion process of the panel assembly process, the substrate is not deformed over the entire the display region 7a and the region 17a outside the display region, and a uniform gap can be formed over the entire display region.

[0014]

[Problem(s) to be Solved by the Invention]

As such, by forming the pole-shaped spacer 5 even in the region 17a other than the display region of the glass substrate 1, the uniformity of a gap including the periphery of the panel is improved and the display quality can be improved accordingly.

[0015]

However, the alignment mark 16 used in a panel assembly process is formed in the region 17a other than the display region, in which the pole-shaped spacer 5 is formed. If the alignment mark 16 and the pole-shaped spacer 5 overlap with each other, it becomes difficult to identify the alignment mark 16 and the pole-shaped spacer 5 in an image recognition apparatus such as a CCD camera. Further, there may occur problem in that automatic alignment through the panel process becomes impossible.

[0016]

Accordingly, an object of the present invention is to provide a liquid crystal display apparatus, a color filter substrate and an array substrate, wherein

alignment failure can be improved while improving the display quality, by forming a pole-shaped spacer in region other than a display region of a substrate.

[0017]

[Means for Solving the Problem]

In order to accomplish the above object, a liquid crystal display apparatus according to Claim 1 of the present invention includes alignment marks, which are formed in regions other than a display region on a pair of opposite substrates having intervening a liquid crystal layer therebetween and are used for positioning, and a pole-shaped spacer formed at one of the opposite substrates. In this case, the pole-shaped spacer is provided at the alignment mark portion and a location of the substrate other than the alignment mark portion.

[0018]

As such, the pole-shaped spacer is provided at the alignment mark portion and a location of the substrate other than the alignment mark portion. Accordingly, when the alignment mark and the pole-shaped spacer overlap with other, a problem in that the alignment mark and the pole-shaped spacer become difficult to identify does not occur. For this reason, in order to make uniform a panel gap, the pole-shaped spacer is formed in the entire substrate. This can improve the display quality and also allows a panel to be formed without alignment failure.

[0019]

A liquid crystal display apparatus according to Claim 2 includes an array substrate having a pixel electrode and a switching active element that drives the pixel electrode, a color filter substrate having an opposite electrode of the pixel

electrode, a pole-shaped spacer having a predetermined pattern shape, a predetermined height and a predetermined density and formed on the color filter substrate, and alignment marks, which are formed in regions other than a display region on the color filter substrate and are used for positioning. In this case, liquid crystal is filled into a gap between the array substrate and the color filter substrate. The pole-shaped spacer is provided at the alignment mark portion on the color filter substrate and a location of the substrate other than the alignment mark portion.

[0020]

As such, the pole-shaped spacer is provided at the alignment mark portion on the color filter substrate and a location of the substrate other than the color filter substrate. Accordingly, in the same manner as Claim 1, when the alignment mark and the pole-shaped spacer overlap with other, a problem in that the alignment mark and the pole-shaped spacer become difficult to identify does not occur. For this reason, in order to make uniform a panel gap, the pole-shaped spacer is formed in the entire color filter substrate. This can improve the display quality and also allows a panel to be formed without alignment failure.

[0021]

A liquid crystal display apparatus according to Claim 3 includes an array substrate having a pixel electrode and a switching active element that drives the pixel electrode, a color filter substrate having an opposite electrode of the pixel electrode, a pole-shaped spacer having a predetermined pattern shape, a predetermined height and a predetermined density and formed on the color filter substrate, and alignment marks, which are formed in regions other than a display region on the color filter substrate and are used for positioning. In this case,

liquid crystal is filled into a gap between the array substrate and the color filter substrate. The pole-shaped spacer is provided at the alignment mark portion on the array substrate and a location of the substrate other than the array substrate portion.

[0022]

As such, the pole-shaped spacer is provided at the alignment mark portion on the array substrate and a location of the substrate other than the color filter substrate. Accordingly, in the same manner as Claim 1, when the alignment mark and the pole-shaped spacer overlap with other, a problem in that the alignment mark and the pole-shaped spacer become difficult to identify does not occur. For this reason, in order to make uniform a panel gap, the pole-shaped spacer is formed in the entire array substrate. This can improve the display quality and also allows a panel to be formed without alignment failure.

[0023]

A color filter substrate according to Claim 4 includes an opposite electrode of a pixel electrode formed on an array substrate. In this case, an alignment mark used for positioning is provided other than a display region, and a pole-shaped spacer having a predetermined pattern shape, a predetermined height and a predetermined density is provided at the alignment mark portion and at a location other than the alignment mark portion.

[0024]

As such, an alignment mark used for positioning is provided other than a display region, and a pole-shaped spacer having a predetermined pattern shape, a predetermined height and a predetermined density is provided at the alignment mark portion and at a location other than the alignment mark portion. Thus,

although the pole-shaped spacer is formed in the entire color filter substrate in order to make uniform the panel gap, alignment in the panel process can be performed accurately.

[0025]

An array substrate according to Claim 5 includes a pixel electrode and a switching active element that drives the pixel electrode, wherein an alignment mark used for positioning is provided other than a display region, and a pole-shaped spacer having a predetermined pattern shape, a predetermined height and a predetermined density is provided at the alignment mark portion and at a location other than the alignment mark portion.

[0026]

As such, an alignment mark used for positioning is provided other than a display region, and a pole-shaped spacer having a predetermined pattern shape, a predetermined height and a predetermined density is provided at the alignment mark portion and at a location other than the alignment mark portion. Thus, although the pole-shaped spacer is formed in the entire array substrate in order to make uniform the panel gap, alignment in the panel process can be performed accurately.

[0027]

[Embodiment of the Invention]

A first embodiment of the present invention will be described with reference to FIGs. 1 to 4. FIG. 1(a) is a schematic cross-sectional view of a color filter substrate according to a first embodiment of the present invention. FIG. 1(b) is a schematic plan view of the color filter substrate shown in FIG. 1(a).

[0028]

As shown in FIG. 1, the color filter substrate includes an array substrate (not shown) having a pixel electrode and a switching active element that drives the pixel electrode, a color filter substrate 1a having an opposite electrode 10 of the pixel electrode, a pole-shaped spacer 5 formed on the color filter substrate 1a and having a predetermined pattern shape, a predetermined height and a predetermined density, and an alignment mark 16, which is formed in a region 17a other than the display region on the color filter substrate 1a and is used for positioning. In a structure in which a gap between the array substrate and the color filter substrate 1a is filled with liquid crystal, a pole-shaped spacer 5 is formed in the alignment mark 16 portion on the color filter substrate 1a and a location other than the periphery of the alignment mark 16 portion.

[0029]

That is, patterning of the pole-shaped spacer 5 is performed by photolithography using the expose mask. At this time, the pole-shaped spacer 5 is not formed in the portion where the alignment mark 16 is formed and the periphery region thereof. A spacer pattern of a predetermined pattern shape is formed in the display region 7a and a region 17a other than the display region using a mask formed in a predetermined density.

[0030]

FIG. 2 is a process cross-sectional view of the color filter substrate according to a first embodiment of the present invention. As shown in FIG. 2(a), a light-shielding layer is first formed on the glass substrate 2a. The light-shielding film 4 of a predetermined pattern shape is patterned through exposure and development. The light-shielding film 4 can include a resin region or the chrome

film separately, if needed. At this time, a desired alignment mark 16 can be formed by patterning the light-shielding layer.

[0031]

Referring next to FIGs. 2(b) and 2(c), the RGB coloring film 6 (6R, 6G, 6B) is coated, exposed and developed to have a predetermined pattern shape. A transparent electrode 10 made of ITO is formed on the RGB coloring film by means of sputtering.

[0032]

Lastly, as shown in FIG. 2(d), after a resin film is formed, a pole-shaped spacer 5 is formed by means of photolithography. The height of the pole-shaped spacer 5 is decided according to a cell gap of a panel.

[0033]

At this time, as shown in a detailed plan view of FIG. 3(b), if the pole-shaped spacer 5 is formed to overlap with the alignment mark 16, alignment failure is generated due to confusion of both patterns when they are automatically recognized by a camera. Thus, as shown in FIG. 3(a), the alignment mark 16 and the pole-shaped spacer 5 are formed not to overlap with each other, and the pole-shaped spacer 5 is not formed in the periphery of the alignment mark.

[0034]

The liquid crystal display apparatus using the color filter substrate 1a will now be described. FIG. 4 is a cross-sectional view of the liquid crystal display apparatus according to a first embodiment of the present invention.

[0035]

When fabricating the TFT type liquid crystal panel 31a, the orientation films 9a and 9b are formed on a surface of the color filter substrate 1a where the pole-

shaped spacer 5 is formed and a surface of the array substrate 11a formed by a common method, which are opposite to each other, respectively. The periphery of both the glass substrates 1a and 11a are sealed with the sealant 13, and a gap between them is filled with the liquid crystal 14 with the pole-shaped spacer 5 therebetween. Thus, the liquid crystal panel 31a is formed. Further, a polarization plate can be attached to the pane surface according to the use of the liquid crystal panel 31a.

[0036]

Furthermore, although a cut alignment mark, an alignment mark of a panel lighting detector, etc. are formed in the liquid crystal panel 31a formed thus, the pole-shaped spacer 5 is not formed on the alignment mark 16 and the periphery thereof.

[0037]

A second embodiment of the present invention will be described with reference to FIGs. 5 to 7. FIG. 5(a) is a schematic cross-sectional view of an array substrate according to a second embodiment of the present invention. FIG. 5(b) is a schematic plan view of the array substrate shown in FIG. 5(a).

[0038]

As shown in FIG. 5, the array substrate includes an array substrate 11b having a pixel electrode 8 and a switching active element 3b that drives the pixel electrode 8, a color filter substrate (not shown) having an opposite electrode of the pixel electrode 8, a pole-shaped spacer 5 that is formed on the array substrate 11b and has a predetermined pattern shape, a predetermined height and a predetermined density, and an alignment mark 16 that is formed in a region 17b other than a display region on the array substrate 11b and is used for positioning.

In a structure in which a gap between the array substrate 11b and the color filter substrate is filled with liquid crystal, the pole-shaped spacer is formed in the alignment mark 16 portion on the array substrate 11b and the periphery thereof.

[0039]

That is, patterning of the pole-shaped spacer 5 is performed by photolithography using the expose mask. At this time, the pole-shaped spacer 5 is not formed in the portion where the alignment mark 16 is formed and the periphery region thereof. A spacer pattern of a predetermined pattern shape is formed in the display region 7b and a region 17b other than the display region using a mask formed in a predetermined density.

[0040]

FIG. 6 is a process cross-sectional view showing an array substrate according to a second embodiment of the present invention. As shown in FIG. 6(a), a transparent electrode film of ITO is formed on the glass substrate 2b. The pixel electrode 8 of a predetermined pattern shape is patterned by means of photolithography.

[0041]

Referring next to FIGs. 6(b) and 6(c), the switching active element 3b is formed by repeatedly performing formation of a common semiconductor thin film and insulation film and etching by a photolithography method. At this time, a desired alignment mark 16 can be formed by pattering the semiconductor thin film.

[0042]

Lastly, as shown in FIG. 6(d), after a resin film is formed, the pole-shaped spacer 5 is formed by a photolithography method.

[0043]

At this time, as shown in a detailed plan view of FIG. 3(b), if the pole-shaped spacer 5 is formed to overlap with the alignment mark 16, alignment failure is generated due to confusion of both patterns when they are automatically recognized by a camera. Thus, as shown in FIG. 3(a), the alignment mark 16 and the pole-shaped spacer 5 are formed not to overlap with each other, and the pole-shaped spacer 5 is not formed in the periphery of the alignment mark.

[0044]

The liquid crystal display apparatus using the array substrate 1b will now be described. FIG. 7 is a cross-sectional view of the liquid crystal display apparatus according to a second embodiment of the present invention.

[0045]

When fabricating the TFT type liquid crystal panel 31b, the orientation films 9a and 9b are formed on a surface of the color filter substrate 1a formed by a color filter method and a surface of the array substrate 11b where the pole-shaped spacer 5 is formed as described above, which are opposite to each other, respectively. The periphery of both the glass substrates 1b and 11b are sealed with the sealant 13, and a gap between them is filled with the liquid crystal 14 with the pole-shaped spacer 5 therebetween, thus forming the liquid crystal panel 31b. Further, a polarization plate can be attached to the pane surface depending upon the use of the liquid crystal panel 31b.

[0046]

Furthermore, although a cut alignment mark, an alignment mark of a panel lighting detector, etc. are formed in the liquid crystal panel 31b formed thus, the pole-shaped spacer 5 is not formed on the alignment mark 16 and the periphery thereof.

[0047]

[Effects of the Invention]

In accordance with the liquid crystal display apparatus of Claim 1 according to the present invention, the pole-shaped spacer is provided at the alignment mark portion and a location of the substrate other than the alignment mark portion. Accordingly, when the alignment mark and the pole-shaped spacer overlap with other, a problem in that the alignment mark and the pole-shaped spacer become difficult to identify does not occur. For this reason, in order to make uniform a panel gap, the pole-shaped spacer is formed in the entire substrate. This can improve the display quality and also allows a panel to be formed without alignment failure.

[0048]

In accordance with the liquid crystal display apparatus of Claim 2 according to the present invention, the pole-shaped spacer is provided at the alignment mark portion on the color filter substrate and a location of the substrate other than the color filter substrate. Accordingly, in the same manner as Claim 1, when the alignment mark and the pole-shaped spacer overlap with other, a problem in that the alignment mark and the pole-shaped spacer become difficult to identify does not occur. For this reason, in order to make uniform a panel gap, the pole-shaped spacer is formed in the entire color filter substrate. This can improve the display quality and also allows a panel to be formed without alignment failure.

[0049]

In accordance with the liquid crystal display apparatus of Claim 3 according to the present invention, the pole-shaped spacer is provided at the alignment mark portion on the array substrate and a location of the substrate other than the

color filter substrate. Accordingly, in the same manner as Claim 1, when the alignment mark and the pole-shaped spacer overlap with other, a problem in that the alignment mark and the pole-shaped spacer become difficult to identify does not occur. For this reason, in order to make uniform a panel gap, the pole-shaped spacer is formed in the entire array substrate. This can improve the display quality and also allows a panel to be formed without alignment failure.

[0050]

In accordance with the color filter substrate of Claim 4 according to the present invention, an alignment mark used for positioning is provided other than a display region, and a pole-shaped spacer having a predetermined pattern shape, a predetermined height and a predetermined density is provided at the alignment mark portion and at a location other than the alignment mark portion. Thus, although the pole-shaped spacer is formed in the entire color filter substrate in order to make uniform the panel gap, alignment in the panel process can be performed accurately.

[0051]

In accordance with the array substrate of Claim 5 according to the present invention, an alignment mark used for positioning is provided other than a display region, and a pole-shaped spacer having a predetermined pattern shape, a predetermined height and a predetermined density is provided at the alignment mark portion and at a location other than the alignment mark portion. Thus, although the pole-shaped spacer is formed in the entire array substrate in order to make uniform the panel gap, alignment in the panel process can be performed accurately.

[Description of Drawings]

FIG. 1(a) is a schematic cross-sectional view of a color filter substrate according to a first embodiment of the present invention. FIG. 1(b) is a schematic plan view of the color filter substrate shown in FIG. 1(a).

FIG. 2 is a process cross-sectional view of the color filter substrate according to a first embodiment of the present invention.

FIG. 3(a) is a plan view showing a state where pole-shaped spacers are not formed on an alignment mark and regions adjacent to the alignment mark according to an embodiment of the invention. FIG. 3(b) is a plan view showing a state where the pole-shaped spacers are formed on the alignment mark and the regions adjacent to the alignment mark for comparison.

FIG. 4 is a cross-sectional view of a liquid crystal display apparatus according to a first embodiment of the present invention.

FIG. 5(a) is a schematic cross-sectional view of an array substrate according to a second embodiment of the present invention. FIG. 5(b) is a schematic plan view of the array substrate shown in FIG. 5(a).

FIG. 6 is a process cross-sectional view showing an array substrate according to a second embodiment of the present invention.

FIG. 7 is a cross-sectional view showing a liquid crystal display apparatus according to a second embodiment of the present invention.

FIG. 8 is a cross-sectional view showing a liquid crystal display apparatus in the related art.

FIGs. 9(a) and 9(b) are explanatory views showing problems of the conventional liquid crystal display apparatus.

[Explanation on Numerals]

1: Color filter substrate

2a: Glass substrate

3: Switching active element

4: Light-shielding film

5: Pole-shaped spacer

6: Coloring film

7a: Panel display region

8: Pixel electrode

9: Orientation film

10: Transparent electrode

11: Array substrate

13: Sealant

14: Liquid crystal

15: Spherical shape spacer

16: Alignment mark

17a: Region other display region

31a: Liquid crystal display device